



# CLEANROOM FACILITIES AT CLEMSON UNIVERSITY

## The Micro Fabrication Facility at Clemson University

is located within The Center for Optical Materials Science and Engineering Technologies (COMSET) at the Advanced Materials Research Lab (AMRL) in Anderson, SC. This facility provides academic and industry researchers easy access to a complete microelectronic, optoelectronic & MEMS fabrication facility. Processing includes; cleaning wafers and photolithography to

metal and oxide deposition as well as plasma etching, metrology and device singulation. Complete fabrication of microelectronic, micro-optic & MEMS devices can be accomplished at Clemson's facility.

The facility was established in 2011, with the arrival of Dr. Eric Johnson as the PalmettoNet Endowed Chair in Optoelectronics. Dr. Johnson, and his graduate students, began research into novel optical devices and were able to realize their device designs by fabricating them at the Micro Fabrication Facility on-site.

Within 3 years, expansion was needed at the Micro Fabrication Facility. The expansion included metal and dielectric deposition and etching; allowing a host of electronic devices to be fabricated in the same cleanroom. At the same time, private local companies expressed an interest to access such a facility with these unique fabrication capabilities.

Currently, the majority of the Facility users are graduate students fabricating devices for their research and industrial users contracting the resident expertise of Clemson's staff.

## Facility Capabilities

- Wet & dry chemical cleaning and etching.
- Plasma etching, both ICP & RIE systems utilizing Fluorine & Chlorine based chemistries.
- ALD & E-beam deposited dielectrics & metals.
- I-Line photolithography
  - Semi-Auto coat & develop tools
  - 5X reduction stepper
  - 1X proximity/contact printer
- User scheduled access to tools.
- Experienced staff for personalized training on all tools.
- Custom tailored processes for specific device projects.
- Process support and guidance as needed



For more information, visit [clemson.edu/cecas/ece-clean-room](http://clemson.edu/cecas/ece-clean-room)



## Equipment

### Wafer Cleaning & Wet Etching

3 wet hoods from Salare Systems in NC for solvent, acid & base etching and wafer cleaning

Typical processes:

- NMP resist strip
- RCA I & II cleaning
- Piranha resist strip (NanoStrip 2X also available)
- Chrome etch (CR-7)
- Tungsten etch
- Gold etch (GE 8148)
- Platinum etch (Aqua Regia)
- Nickel etch (HNO<sub>3</sub> + Perfluoroalkyl Sulfonate)

### Additional Wet hoods

- Sulfuric acid, Hydrogen Peroxide (Piranha Strip)
- Hydrochloric Acid & Hydrogen Peroxide (RCA II cleaning)
- Ammonium Hydroxide & Hydrogen Peroxide (RCA I cleaning)
- NMP, Acetone & Methanol (Solvents)

### Resist Coating & Developing

- Semi-automated resist coater with integrated hot plate
- 100mm tooling

### Brewer Sciences Photo Resist Developer Tool

- Semi-automated wafer spin developer with integrated hot plate
- 100mm tooling

### UV Exposure

#### Nuetronix/Quintel 1X Contact/Proximity Printer

- 365nm exposure wavelength
- Currently configured for 100mm wafers
- Mask tooling for 4, 5 and 7" masks
- Tooling available for 150mm wafers
- IR back to front alignment capable

#### GCA 5:1 Reduction i-line optical stepper

- 0.45na
- 365nm exposure wavelength
- Critical dimension (resolution) 0.5um
- Overlay 150nm XBar + 3 sigma
- Currently configured for 100mm dia. wafers, can expose up to 200mm wafers 0.25mm to 1.0mm thick
- Customized Tooling for exposing 5" X 5" X 0.150" photomasks
- Utilizes 5" X 5" reticles
- Processing of piece/parts is possible with custom tooling

### Plasma Etch

#### PlasmaTherm Versaline ICP

- Fluorine gases for SiO<sub>2</sub> and Si & Ge etching as well as other semiconductor materials
- Configured for 100mm wafers up to 1mm thick
- RIE and or ICP modes
- Primarily used to dry etch SiO<sub>2</sub> & Si films and bulk material

#### Oxford Instruments Plasmalab 100 ICP

- Utilizes CL2 & BCL3 etch chemistry for metal or dielectric etching
- Configured for 100mm wafers up to 1mm thick
- Tool can etch up to 10mm thick wafers with optional tooling

- RIE and or ICP modes
- Currently used to dry etch Sapphire & Chromium

### Dielectric Conformal Deposition

#### Atomic Layer Deposition (ALD)

Oxford Instruments OPAL ALD tool utilizing the following pre-cursors:

- Diethyl zinc
- Tetrakis(ethylmethylamino) hafnium (IV)
- Titanium(IV) isopropoxide
- Trimethylaluminum

### Metal & Dielectric Deposition

#### Electron Beam Deposition

- CCS CA-40 e-beam evaporator configured for 100mm wafers

### Metrology

- Nikon Optical microscope magnification to 1500X
- Tencore Alpha Step 200 profilometer
- Hitachi S-4800 Scanning electron microscope access on site at Clemson Universities EM facility
- Filmetrics F20 UV Optical thin film measurement tool

### Wafer Dicing

#### K&S Wafer Dicing Saw

- Model 780
- 200mm capable
- Cuts silicon, sapphire & optical glasses

### Wire Bonding

#### K&S Wire Bonder

- Model 4525AD
- Gold wire 0.18um to 76um
- Man & Auto



## Cleanroom Pricing through June 30, 2018

	Unit of Billing	Daily Rate	Weekly Rate	Monthly Rate	90 Day Rate	6 Month Rate	Flat Rate Yearly
CU Students*	Per Student/Project	\$250	\$700	\$1,550	\$3,000	\$4,400	\$6,500
External Customers*	Per User/Project	\$800	\$2,240	\$4,960	\$9,600	\$14,080	\$20,800

\* Use of all fabrication tools located at AMRL within the Micro Photonics Cleanroom and Lab 23, all inclusive. Users will be responsible for providing all wafers and materials. All chemicals and materials needed for any project are to be approved prior to granting access to the cleanroom by the MPL manager. Precious metals used in the evaporator are an additional charge by weight used. All chemicals brought into the cleanroom are available for use by all users. Priority is given to the primary project supplying the material.